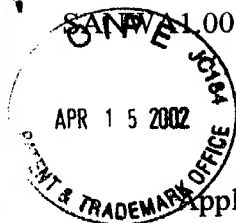


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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE



Applicant : Ishiwa, et al.

Appl. No. : 09/779,691

Filed : February 7, 2001

For : MULTILAYER CIRCUIT
BOARD

Examiner : Quynh-Nhu H. Vu

) Group Art Unit 2841

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(Date)

Thomas R. Arno, Reg. No. 40,490

AMENDMENT AND RESPONSE TO OFFICE ACTION

United States Patent and Trademark Office
PO Box 2327
Arlington, VA 22202

Dear Sir:

In response to the Office Action mailed November 13, 2001, Applicant respectfully submits the following amendments and remarks in connection with the above-captioned application.

IN THE CLAIMS:

Please amend Claims 1 and 9 as follows:

1. A multilayer circuit board having a multilayer structure, comprising:
- a plurality of printed wiring boards including at least a first printed wiring board and a second printed wiring board, wherein each of said first and second printed wiring boards includes a metal core substrate having a first major surface and a second major surface which are opposite and parallel to each other;
- an electrically insulating layer at least partially covering each of the major surfaces;

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contd

Appl. No. : 0/779,691
Filed : February 7, 2001

a conductive printed wiring layer formed on the surface of said electrically insulating layer and including a plurality of wiring lines;

a solder resist layer partially covering the surface of said conductive printed wiring layer;
and

wherein each metal substrate comprises a plurality of integral metal projections of a predetermined height on at least one of said first major surface or said second major surface so as to provide an air gap between the adjacent printed wiring boards in said multilayer structure,
and

wherein said solder resist layer comprises at least one local opening for exposing metal surface at a region corresponding to at least one of said metal projections.

42

9. A multilayer circuit board according to claim 1, wherein the second major surface of said first printed wiring board and the first major surface of said second printed wiring board face each other through an air gap in said multilayer structure, and wherein each metal substrate includes a combination of a metal projection formed on one of said second major surface of said first printed wiring board and said first major surface of said second printed wiring board and a local exposed metal portion provided on the other of said second major surface of said first printed wiring board and said first major surface of said second printed wiring board at a position in alignment with said metal projection.

Please add the following new Claim 11:

43

11. (NEW) A multilayer printed circuit assembly comprising a plurality of printed circuit boards having metal cores, wherein at least one adjacent pair of said plurality of printed circuit boards are separated by raised portions of said metal cores.

REMARKS

In response to the Office Action mailed November 13, 2001, Applicant respectfully requests the Examiner to reconsider the above-captioned application in view of the above amendments and the following discussion.

Appl. No. : 09/779,691
Filed : February 7, 2001

Claims 1 and 9 have been amended. The amendments to Claim 1 are supported by original Claim 1 and Figures 1-3 and their corresponding description. The amendments to Claim 9 are supported by Figure 4b. Therefore, the claim amendments do not introduce any new matter.

Claim 11 has been added and is supported by original Claim 1 and Figures 1-3 and their corresponding description. As a result of the amendments listed above, Claims 1-11 are pending in this application.

The specific changes to the amended claims are shown on a separate set of pages attached hereto and entitled VERSION WITH MARKINGS TO SHOW CHANGES MADE, which follows the signature page of this Amendment. On this set of pages, the insertions are double underlined while the ~~deletions are struck through~~.

Discussion of Rejections under 35 U.S.C. § 103(a)

The Examiner has rejected Claims 1-10 under 35 U.S.C. § 103(a) as being unpatentable over Bregman (U.S. Patent No. 5,786,986) in view of Abolafia (U.S. Patent No. 3,795,047). However, the presently pending Claims are patentably distinguished from the prior art as discussed below.

Presently pending Claim 1 comprises a plurality of printed wiring boards each of which includes a metal core substrate having first and second major surfaces. In addition, each metal substrate comprises a plurality of integral metal projections of a predetermined height on at least one of the major surfaces. None of the cited references discloses, suggests or teaches the features recited in the claimed invention.

Bregman does not disclose integral metal projections recited in Claim 1

Bregman discloses first and second substrates (4, 6) each having a conductive core (12) that includes two major surfaces (17, 20) (column 4, lines 5-33; Figure 1). However, as clearly shown in Figures 1, 2, 6 and 7, no substrate (4, 6) in the Bregman reference includes any integral metal projections of a predetermined height to provide an air gap on at least one of the major surfaces as recited in presently pending Claim 1. Referring to column 4, lines 34-45, Bregman discloses that conductors 36' and 44' are electrically connected to a core (12). In addition, an electrical conductor 90 is fabricated by plating up metal lines onto the exposed surface 92 using a

Appl. No. : 09/779,691
Filed : February 7, 2001

photoresist, and a metal line 102 has been electroplated onto the plating base 92 (column 8, lines 47-64; Figure 6). Thus, conductors (90, 102, 36', 44') in the Bregman reference are formed as current carrying conductors and are not of a predetermined height so as to form an air gap. In Bregman, the main component of the air gap is the solder ball 42, which is a disadvantageous construction as discussed in paragraph 10 of the specification. In contrast, the projections form the main component of the air gap in the present invention, providing increased stability and easier manufacture of the entire assembly.

Abolafia discloses neither a metal core substrate nor integral metal projections recited in

Claim 1

Referring to Figures 2, 4, 6, and 7 and their corresponding description, Abolafia only discloses joining printed circuit cards (10a, 10b) which consist of dielectric layers (2a 2b), metallic layers (3a, 3b), and epoxy layers (4a, 4b), respectively, using a metal powder particulate (18). That is, as shown in Figures 1, 2 and 7 of Abolafia, and as indicated in the background of the Bregman reference (column 2, lines 1-6), Abolafia (U.S. Patent No. 3,795,047) does not disclose a metal core substrate, which is recited in the claimed invention. Furthermore, the Abolafia reference does not disclose metal projections on either of the printed circuit cards (10a, 10b).

No teaching or suggestion exists in Abolafia to combine Bregman to create the claimed invention

As discussed above, the Bregman reference does not disclose, teach or suggest the metal projections of Claim 1, and the Abolafia reference does not disclose, teach or suggest the metal substrate (conductor) and the metal projections. Therefore, there is no teaching or suggestion to combine the Abolafia reference with the Bregman reference to arrive at the presently claimed invention. In addition, even if the references could be combined with each other, the combination does not teach or suggest the presently claimed invention.

In view of the above discussion, presently pending Claim 1 would not have been made obvious by the Bregman and Abolafia references.

Appl. No. : 9/779,691
Filed : February 7, 2001

Claims 2-10 depend from base Claim 1 and further define additional technical features. Thus, the dependent claims are also patentable.

Regarding Kyoungoku, et al (U.S. Patent No. 5,995,379), Burgess, et al (U.S. Patent No. 4,803,450), Tamburro (U.S. Patent No. 4,155,321), Crepeau (U.S. Patent No. 4,249,302), Lunine (U.S. Patent No. 3,436,819) and Ryan (U.S. Patent No. 3,606,677), none of them discloses the metal substrate comprising a plurality of integral metal projections on at least one of the major surfaces recited in the claimed invention. Thus, the claimed invention is neither anticipated by nor would have been made obvious by the above references either.

Therefore, withdrawal of the rejections is respectfully requested.

Discussion of New Claim

The new Claim 11 has been added in this paper. Claim 11 comprises a plurality of printed circuit boards having metal cores, wherein at least one adjacent pair of said plurality of printed circuit boards are separated by raised portions of said metal cores. That is, the adjacent printed circuit boards are separated by raised portions of the metal cores in Claim 11. Neither Bregman nor Abolafia discloses the features recited in Claim 11. Therefore, Applicant believes that the new Claim 13 is also patentably distinguished from the prior art.

Appl. No. : 9/779,691
Filed : February 7, 2001

CONCLUSION

In view of the foregoing amendments and remarks, it is respectfully submitted that the present application is in condition for allowance. If the Examiner has any remaining concerns which might prevent the prompt allowance of the application, the Examiner is respectfully invited to contact the undersigned at the indicated telephone number.

Respectfully submitted,

KNOBBE, MARTENS, OLSON & BEAR, LLP

Dated: 4/9/02

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